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# PLANT PROTECTION OVERSEAS REVIEW

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# PLANT PROTECTION OVERSEAS REVIEW

A PERIODICAL SURVEY OF NEW DEVELOPMENTS IN THE CONTROL OF PESTS, DISEASES AND WEEDS

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# EDITORIAL

IN an article entitled " The Fight Against Some Important Insect Pests in South Africa " by Mr. A. B. M. Whitnall, published in Vol. 2, No. 2 of this Journal, brief references were made to some of the destructive insect pests attacking citrus orchards in South Africa. In the present issue of the " Overseas Review ", the problems presented by some of the pests of this important South African crop are discussed at greater length from the points of view of their ecology and control by chemicals.

Another article from South Africa deals with the control of mealybug on vines with chemicals, drawing attention to the use of parathion ( ' Fosferno ' ). Both these contributions are from entomologists of African Explosives and Chemical Industries Ltd. with wide experience of the problems discussed.

We have also published, by kind permission of Dr. ten Houten of the I.P.O., Wageningen, Holland, and the Editor of the " Mededelingen van de Directeur van de Tuinbouw ", a condensed version of an address made by Dr. ten Houten, originally published in the above-mentioned journal, giving an account of the wide range of research problems on which the staff of this important scientific institution in Holland have been and are engaged.

We welcome also an article which, while not dealing with insect pests and their control at the present day, is nevertheless of interest in that it comments on early researches in entomology by an eminent naturalist, with a summary of a comprehensive volume written by him in Latin on insects and their habits, which is not readily available to the present day reader and thus not widely known.

# "UNTAKEN HARVEST"

WE are pleased to announce the publication during July of a book aptly entitled "Untaken Harvest" * by Mr. F. G. Ordish, B. Sc. (Econ.), Dip. Hort., of the staff of Plant Protection Ltd.

The untaken harvest to which the author refers is the sum total of the enormous losses caused by plant pests and diseases. As our resources for fighting them both in the laboratory and the field are limited, Mr. Ordish, in this first book of its kind, urges a closer study of the economics of the subject. This would enable both a better use to be made of our existing knowledge and manpower, and ensure that research was directed to the most urgent problems.

This book will no doubt be read with profit by all those who are interested in the utilization of the acres at present yielding produce for the benefit of insect pests and disease organisms and in decreasing this untaken harvest.

* ("UNTAKEN HARVEST." George Ordish, B.Sc. (Econ.)
Foreword by Viscount Bledisloe, P.C., G.C.M.G., K.B.E., M.R.A.C.
171 pp., 4 graphs, 14 tables, bibliography, index.
Constable & Coy., Ltd., LONDON, price 15/-).

Summary of an address entitled

# SOME ECONOMIC ASPECTS OF DISEASES AND PESTS IN AGRICULTURE AND HORTICULTURE

in connection with the Problems which are being investigated by the Institute for Phytopathological Research (I.P.O.)

by Dr. J. G. TEN HOUTEN

Director of the I.P.O. on the occasion of the opening of their new building

*Published by kind permission of Dr. J. G. ten Houten and the Editor of "Mededelingen Directeur van de Tuinbouw", in which the full address was printed.*

DR. TEN HOUTEN expressed his gratitude to the various speakers for their words of praise regarding the institute and especially to the General Secretary of the Ministry of Agriculture, who had found time to open the new laboratory.

The institute has a great task to fulfil in ensuring that Holland will succeed in nourishing adequately in the future its greatly increased population. Through improved cultivation methods and the use which has been made of the results of scientific research, agricultural and horticultural production has already, since 1935, increased to a higher degree than has the population.

An impression of the capital which the soil of Holland produces yearly can be obtained by the following figures —

In 1938 the gross production value of agriculture and horticulture together amounted to upwards of 275 million guilders, while in 1949 it amounted to approximately four times as much.

No further explanation will, therefore, be required for the great care which it is necessary to give to the soil, including the application of large quantities of fertilizers and manures and for the rigid avoidance of predatory cultivation.

As a result of this steady extraction of substances from the soil, various deficiency diseases occur through the failure of manuring to replenish the stock of trace elements essential for normal plant growth. Up to the present the I.P.O. has been engaged on investigating nutritional diseases which occur in fruit cultivation only, for which work Dr. Mulder, attached to the Zeelands Proeftuin, has achieved a world wide reputation.

Miss Schreuder, in Groningen, and Mr. Labruyere in Wageningen, both on the I.P.O. staff, are studying the serious wilts and foot rots of peas, in which soil-borne fungi and probably eelworms play a part. Other aspects of these and other diseases of peas are being studied by Dr. Kerling of the Agricultural University, and Dr. Goossens of the Phytopathological Service, whilst members of the I.P.O. staff investigate important entomological problems presented by the pea gall midge (*Contarinia pisi*) and the pea weevil (*Sitona lineatus*), both of which cause serious losses.

**Economic importance of Disease Control**

Emphasising financial losses due to diseases and pests may not be justified under conditions of surplus production, when control of a pest may lead to a lowering of the price of the product. In general, however, there is a world shortage of food and therefore there is need for a complete understanding of the probable economic results of control or failure to control pests and diseases. Although much depends on the market situation, the fact remains that efficient control of pests and diseases is always to the advantage of the whole community.

According to the Americans, Stevens and Wood, the more even rate of production resulting from pest and disease control considerably reduces the possibility of overproduction or shortage. The statement of Morstatt in Germany in 1923 pointed out that individual damage only appears to concern the producer; but the total harvest has an influence on economy as a whole. This applies to Holland as well. Thus it is clear that an increased food production is of the greatest importance.

It seems that in almost all the 15 countries which took part in an enquiry organised by the Food and Agricultural Committee of the O.E.E.C. detailed statistics regarding the damage caused by plant parasites were not available, some countries giving a very rough estimate, which, in the case of the Netherlands, seemed definitely on the low side.

An institute like the American Plant Disease Survey is needed in Europe, and in Holland itself there should be an organization created to concern itself with the accurate determination of plant disease losses as proof of the necessity and efficiency of plant protection, among other reasons.

**Damage in Fruit Growing**

A great number of pests and diseases in Holland occur in connection with fruit growing. In this culture also, control is most thoroughly carried out.

Mr. Evenhuis, who, as a member of the I.P.O. staff is attached to the Fruit Experimental Station in Zeeland, is trying to determine the correct time for spraying DDT, lead arsenate or parathion against the codling moth on apples by relying on climatological and phenological observations. The moth is a serious pest on a crop which, in

1949, was valued at 51 million guilders. It flies for a long period, mainly during dusk and at night under rather cool temperatures. (15° to 16° C).

Mr. De Jong, of the entomological laboratory of I.P.O. in Amsterdam, started in 1949 a study of the many kinds of leaf-rollers, which since the war have caused great damage in apple orchards.

As a result of trials made by Prof. Kuenen and Mr. Van de Vrie, the head assistant in Zeelands Exp. Station, apple blossom weevil and apple sawfly can now be successfully controlled by DDT and BHC, though the use of them, especially DDT, favours red spider attack. This, however, can be controlled by parathion. Dr. Mulder, who works in Zeelands Exp. Station, is studying not only nutritional diseases but also the very destructive apple scab. The correct time for spraying against scab has to be determined not only with relation to the scattering of the ascospores in early spring, but also to the risk of infection of the leaves in relation to their development, and the prevailing weather conditions.

Research work in Zeelands Exp. Station has determined the correct time for DDT spraying against the once so much dreaded pear blossom weevil, which previously caused considerable damage to the fruit crop next in importance to the apple.

Other items of important research work on fruit pests and diseases include the following :—

(*a*) Work on the biology and phenology of the little known, but occasionally very destructive, weevil borer, *Agrilus sinuatus*, by Dr. Leefmans, Head of the Entomological Laboratory of the I.P.O. in Amsterdam.

(*b*) Work on a bacterial bark canker and virus diseases of stone fruit, the crop value of which amounts to about 15 million guilders, by Miss Krijthe at Wageningen.

(*c*) Work by Dr. Grosjean at Wageningen on the destructive silver leaf disease of plums, to cure the trees ; against this disease chemotherapy has been tried with some success.

(*d*) Work on the destructive virus diseases of strawberries and raspberries by Dr. de Fluiter, amongst others, who, in co-operation with their aphid specialist, Mr. Hille Ris Lambers, is studying the possibility of the transmission of the virus by aphids from wild blackberries to cultivated raspberries.

(*e*) In close co-operation with the staff of the Institute of Horticultural Plantbreeding, I.P.O. workers are studying resistance to diseases, including some destructive soil-borne fungi attacking the strawberry, a crop which produced a return of 14.5 million guilders in 1949.

**Market Gardening**

Projects of research on the control of diseases and pests in this important section of horticulture are as follows :—

(*a*) Estimation of resistance to leaf mould (*Cladosporium fulvum*) of tomato varieties under glass at the Experiment Station for

Fruit and Vegetables under glass at Naaldwijk. I.P.O. supplies infection-material of the various physiological races of the fungus.

(*b*) Studies of the virus diseases of French beans and other beans, by Mr. Van der Want, who discovered that bean virus also occurs in gladioli, without showing clear symptoms in the latter.

(*c*) Study of the gallmidge causing ' cabbage top ' of cauliflowers, by Dr. Leefmans, who discovered an efficient crop protection material, pyridine, and determined the correct time for effecting control. As a result, the cultivation of cauliflowers has been freed from one of its greatest hazards.

(*d*) Research on the destructive cabbage fly by Dr. De Wilde, guestworker of the I.P.O., which has resulted in adequate control of this pest, and on the black leaf speck of cabbage, which caused in 1949 losses amounting to about 1 million guilders in Broek op Langendijk alone.

(*e*) Former research on *Fusarium* wilt of cucumbers, from which this valuable crop has suffered serious losses, resulted in a successful grafting of our susceptible varieties on a resistant wild Cucurbita species. On mildew, damping off, root-rot and virus diseases of gherkins, our I.P.O. colleague, Dr. Tjallingii at Venlo, is carrying out investigations.

(*f*) Research by Mr. Van 't Sant, entomologist with the I.P.O. attached to the Exp. Garden of the fen areas of North and South Holland and Utrecht, on the carrot fly, *Psila rosae*, which destroys approximately 10% of the carrot crop, including winter carrots.

(*g*) Investigations on the fungus disease of carrot seed, caused by *Phomopsis*, and a rot of chicory, caused by *Sclerotinia sclerotiorum*, on which problems Miss Bakker is engaged.

**Ornamental Plants**

Flowers constitute a most valuable source of revenue in Holland, and investigations on the numerous diseases and pests of these crops include the following :—

(*a*) Work on the Prunus borer, which used to destroy 8—10% of heavily bearing bushes and which is now controllable, and on a destructive snoutbeetle of cyclamens, under the direction of Dr. Van Marle.

(*b*) Studies of the spider mite attacking roses and carnations in glasshouses.

(*c*) Investigations on the dreaded stem rot (*Phialophora cinerescens*) and virus diseases of carnations, the latter studies being under the direction of Mr. Noordam, in co-operation with Prof. dr. Thung, Head of the virological department of the I.P.O. at Wageningen.

**Field Crops**

The control of pests and diseases of potatoes takes a most important place in the research work of I.P.O., as this crop provides a very fruitful source of foreign currency for Holland.

Mr. Kole, working in Wageningen, is studying powdery scab (*Spongospora subterranea*), which causes damage in some districts, especially in the N.E. fen district, Dr. Seinhorst, I.P.O. nematologist in Wageningen, is studying potato ellworms, *e.g.*, *Ditylenchus destructor* and the stem eelworm and Dr. Oostenbrink of the Phytopathological Service is working on the problems of the potentially even more dangerous cyst-forming eelworm, *Heterodera rostochiensis*, which has rendered potato cultivation impossible in some parts of England. The once disastrous Potato blight (*Phytophthora infestans*), which caused the historic Irish famine, can now be controlled in some measure in Holland by intensive spraying with Bordeaux mixture, or other copper sprays, the times of application of which are determined by reliance on weather forecasts given by the K.N.M.I. (Meteorological Institute) in Bilt. Losses in the Netherlands from this disease, nevertheless, still amount to an average of 2—10%.

Virus diseases of potatoes, which are numerous in Holland, cause great losses. They are being investigated by the Laboratory of Phytopathology, where Prof. Quanjer started his excellent work, and which is being continued by Mr. Rozendaal assisted by a virologist from the I.P.O. The aphid vectors of the viruses are being studied by Mr. Hille Ris Lambers.

Dr. De Wilde and his pupils in the Physiological Laboratory of the Gemeentelijke University of Amsterdam have done excellent work towards the control of the destructive Colorado beetle, including advice as to the correct time for control measures to be applied, but most of their work has a fundamental physiological character including the influence of temperature on all stages of the insects.

Dr. Mooi, who works with the I.P.O. in Wageningen, is studying the control of dry rot of potatoes in storage and during transport, caused by *Fusarium* sp., by means of tetrachloro nitrobenzene, amongst other methods. The very important seed potato variety Bintje is very susceptible to this fungus, especially when grown in sandy soils.

Though relatively little work is being done by I.P.O. workers on the diseases of cereals, Dr. Seinhorst is investigating the problem of stem eelworm attack on rye, and Mr. Kole is studying the control of loose smut by means of the new German hot water treatment, as developed by Prof. Gassner.

Research on the susceptibility of bean varieties to anthracnose and halo blight is being carried on by Mr. Labruyere, following the preliminary investigations of Mr. Van der Want.

**Virus Diagnosis**

The pressing need of a rapid method of virus disease diagnosis is the basis of the researches of Prof. Van Slogteren, Director of the Laboratory of Bulb Research at Lisse, and Prof. Thung and Mr. Van

der Want of the I.P.O. The former is concentrating especially on serology. Where the use of this principle is not possible, the other research workers try to discover other methods, such as the use of chromatography. Such a rapid method of diagnosis would, for example, enable workers to determine with certainty whether or not the viruses of potatoes had passed from the stems into the tubers, and thus obviate the present undesirable necessity of early harvesting of seed potatoes which are threatened by virus attack.

**Phenology**

Dr. Leefmans has repeatedly stressed the importance of phenological observations, which, with the aid of the radio warnings of the Dutch Phytopathological Service, should determine the correct time for applying control measures, upon which the success of such measures mostly depends.

**Application Methods**

In plant protection, the great importance of the correct method of application—by mechanical means—of effective chemicals has been emphasised by Prof. French in Ithaca. Application of crop protection chemicals from the air by means of atomizer sprayers at low gallonage per acre is now being carried out in the Netherlands. Under the supervision of Dr. Maan of the I.P.O., tests are being made with helicopters of different types and a fixed wing aircraft of the Stinson Vigilant type, placed at our disposal by H.R.H. Prince Bernhard, in comparison with ground atomising apparatus. In 1950, 4,500 acres of rape seed were sprayed. This important oil crop suffers greatly from the attacks of many harmful insects.

Accurate entomological observations are being carried out under the direction of the I.P.O. entomologist, Dr. Fransen, who is also studying the economical application of crop protection products by means of ground atomizers.

Dr. Ten Houten concluded his address by mentioning some of the circumstances which led to the erection of the new building. He also expressed his gratitude to the Agricultural University for their offer of the use of the grounds and the library of their Phytopathological Laboratory. He considered it a great privilege to be allowed to work in close co-operation with his friend, Prof. Oort, and to have the opportunity of enjoying his great hospitality. He hoped that the exceptionally good relationship of the staff of both laboratories would long be upheld for the promotion of effective control of pests and diseases in Netherlands agriculture and horticulture.

# DE ANIMALIBUS INSECTIS

'Academic Entomology.' Ulysses Aldrovandi. 1522—1605.

By J. LANGFORD HILLING.

THE 'Natural History' of Pliny and the various recorded observations of Cicero and Virgil in a similar field are old acquaintances of the entomologist, naturalist and botanist, but the carefully collected and detailed work of Ulysses Aldrovandi is, I believe, not so widely known. Perhaps, therefore, the following abbreviated history of his life, and comments on his work, will be of interest to those who find in investigating the early work on their subject almost as much interest as in the subject itself.

Ulysses Aldrovandi, the son of a well-to-do Italian nobleman, was born in Bologna in 1522. His comprehensive formal education was greatly aided by the cultural background common to the nobility of the period. The leisure afforded by wealth enabled him to concentrate wholly upon the subjects of his choice, and he became in 1568 Professor of Natural History at the University at Bologna. So great was his knowledge of and interest in this subject that he prevailed upon the Senate of Bologna to establish there a Botanical Garden, the first of its kind in Italy. For his services, both in the University and in field study, he was appointed its first Director, and with his students collected there, over many years, a wide variety of plant life both wild and hybrid. It was in his honour that the plant known to us as "Venus Fly Trap," fairly common in parts of the Americas, was named by Linnaeus *Aldrovanda vesiculosa*.

At the time of his appointment to the Directorate of the Botanical Gardens, Aldrovandi also held the post of "Inspector of Drugs," and in that capacity published in 1574 a vast work bearing the title "Antidotarii Bononensis Epitome." So comprehensive was this book that it became the pattern for most of the subsequent Pharmacopoeias in his own and other countries. His wide and careful researches in his professorial capacity and his work in connection with the Botanical Gardens have been published in a great "Natural History." The first three volumes dealing entirely with ornithology appeared in 1579 and the fourth volume, "De Animalibus Insectis," in 1602.

The last mentioned is a work of great length covering over 700 pages of 52 closely written lines each and is most profusely and carefully illustrated, as will be seen by the accompanying photographs.

The entire work is in Latin, and there being no translation into English, or, for that matter, any other language, I spent several days in the Library of the Natural History Museum at South Kensington translating those sections most closely related to present day entomology.

It is, of course, an academic treatise and deals with the habits, customs, general patterns of behaviour and usefulness or otherwise of the insects described in each chapter or section. The reason for there being no translations from the Latin is, I presume, on account of this academic approach, although the work is cross-indexed in Latin, Greek, Hebrew, Arabic, Indian, Italian, French, Spanish, German, Belgian, Polish, English, Hungarian and Bohemian in that order.

" De Animalibus Insectis " commences with a most comprehensive section on the bee, followed by one on the wasp, and proceeds through the apparently endless assemblage of insects now known to us as *Hymenoptera*—to beetles, worms, slugs and on to a separate section on aquatic arthropods.

Taking insect after insect he discourses on their general habits, the morals of both sexes, their names and usage in the sphere of medicine, their appearances in literature, art or the coinage of the period, their general usefulness or otherwise, and their capacity for inflicting injury to man and beast, and, in applicable cases, its damage to crops. Remedies are given (mostly herbal or primitive) for the relief of stings and bites to either man or animals. A poultice of boiled white clay is suggested as an antidote for the stings of bees and wasps, flies and allied insects.

It is obvious from the length and general information given in the section on bees that these gregarious and tireless insects were looked upon then as they are now with great admiration. They were well cared for, not only for their honey, which in that period was used in medicine and in the making of some nectars and wines of great delicacy (the grape abounding), but also for their wax, which had many uses. The drawings of bees are many and varied, and the plates are carefully detailed. It is somewhat difficult to reconcile the quoted species with those familiar to us ; but from the text and study of the illustrations it can, I think, be assumed that, as well as the honey bee (*de Ape*), the large red bumble bee (*Bombus lapidarius*), the earth bumble bee (*Bombus lucorum*) and the cuckoo bee (*Psithyrus*) as known to us were also familiar to him, as were many varieties of wasps apart from the common wasp (*Vespa vulgaris*), the tree wasp (*Vespa sylvestris*) and many others, although their general names differ in many cases.

The photographs here reproduced of the drawings of locusts, etc., will give some idea of the careful precision of his illustrations ; not only in bees and wasps and their kindred species where the stomites are so well defined by nature, but in other more subtly divided smaller species his drawings are equally clear—the propodeum, tergites, sternites and the slender pedicel are well lined, but even the brief ovipositors and the transparent hyaline membrane of the wings of the many *Hymenoptera* are delicately drawn in. It is easy to see why the work was in his day, and for some time after, regarded as a standard textbook, and was so popular that it ran into three editions, the last being edited and published by some of his students some 30 years after his death.

The coins photographed bearing the images of Governors, wheat and other devices accompanied by a bee or bees will serve as a reminder of the importance placed by all classes of the populace on the agrarian virtues. There are many coins illustrated in the volume carrying the images of various insects allied to local crafts and laurel crowned Governors, having upon their reverse sides Roman and Greek script and figures.

Throughout his work Aldrovandi quotes many proverbs and passages in prose and verse from Pliny, Cicero, Virgil and Catullus, especially in his chapter on locusts (*Locustis*) and their species. He writes at length of their devastation of crops and herbage, of their being the cause of disease and famine, not only in Italy but in Greece and other lands, especially Egypt; he mentions the great plague in that country in the 2nd century and the havoc wrought thereby, but in no instance does he report upon any measures taken to prevent damage of crops by locusts or other insects known to cause serious destruction. He suggests only remedies for their stings and bites to men and animals, again boiled white clay or baked laurel and bay leaves. Apparently no steps whatever were taken to protect crops, save prayer and incantation. In some cases where the old gods were viewed with greater respect for their capacity to deal with locust hoards, a votive offering was made. Here perhaps the example was followed of the Mantuan Virgil, who, shy as a peasant in the Roman Courts, had cut upon his waxen tablets, verses and calm tales of his house and vineyards, to induce the gods to keep the locusts in their own laps and to see that his bees swarmed in the appropriate hives—this with success, or so the erudite pastoral poet convinced the perhaps too credulous farmers. All this was many centuries ago. It is only during this last one that the entomologists, too far tried by the whims of those whose laps contained unlimited locusts for flinging far and wide, have been able, so to speak, to return the undesired insects unfed and lifeless to the no doubt astonished laps. What a wonderful Georgic Virgil would have made of this !

In the section on the fly (*Musca*) mention is made very specifically of the grape fly (*Musca vinaecorum*): vines being cultivated in great abundance, it was no doubt a source of much anxiety. The stinging fly (*Oestro*) (possibly a gad fly) is also referred to with a host of others; but no specific mention is made of any parasitic species, although the author illustrates several insects resembling closely those known to us as the chalcid (*Polynema natans*) and the proctotrypid (*Telenomus bombycis*).

It seems that in those less enlightened days the destruction of crops by parasitic or other means was considered inevitable, and but few, if any, real steps were taken to prevent the disasters. Here I recalled the third Georgic of Virgil and his comments on the horse or beast fly; perhaps he, being a farmer as well as a poet, took a less sanguine view of that insect !

Another interesting section is that dealing with ants and their kindred (*Formicae*). They are minutely described and referred to as

silent workers, and numerous species are chronicled, corresponding, so far as can be ascertained from the text and illustrations, to our own *Formicoidae*, such as the meadow ant (*Formica pratersis*), narrow headed ant (*Formica exsecta*) and the red ant (*Formica rufa*), to name but a few. This insect is said to sting and leave a small pustular swelling and much irritation, which can be relieved by the application of the afore-mentioned poultice of white clay (boiled) or baked laurel and bay leaves.

The mole cricket (*Talpa ferrantes*) is carefully described, and seems to have been as well known then as it is to us—it is designated a clever silent worker much resembling the ant in behaviour.

Butterflies (*Papilionibus*) are described in great variety and beautifully illustrated. The photograph shows the very painstaking detail of the method used for setting the wings in a raised arc. This method was used by Pliny and other early naturalists and by many entomologists into the 18th century.

The foregoing descriptions of insects are but a fraction of those contained in this great naturalist's work, but they will show his meticulous attention to the smallest detail in both observation and illustration.

The ' Natural History,' as well as the three volumes on ornithology mentioned earlier, contains also a work devoted to ' Monsters,' again profusely illustrated. Some of the animals described therein are obviously freaks, such as the dragon-like lizards and three-horned beasts which from time to time occur in the animal kingdom, much as Siamese twins and double-headed ' monsters ' appear in human reproduction. A perusal of this work brought to mind the ' Natural History ' of a later writer—Topsel, about 1658—to whose book I turned for comparison. Here I noted the drawing of a unicorn, which was carefully described in all seriousness not as a monster, but as a then rare but still extant species of mammal. Being under the impression that unicorns were mythical beasts, appearing only at full moon in fields of the finest malting barley and approachable by only the purest and fairest of virgins, I quickly consulted the Oxford and kindred dictionaries, which confirmed their mythical origins. Topsel obviously left much to be desired as an authority for comparison. His work was published some years after Aldrovandi's, and though much of it was collected from Gestner's observations, he should as a naturalist have known that if, in fact, a single-horned beast, bearing a resemblance to the legendary unicorn was seen at any time, it was obviously a freak, the horn being probably hardened secretion from a sinus in its forehead, corresponding with the sebaceous ' horns ' on hands and noses seen in a certain rare disease in man. His imagination, I fear, triumphed over his anatomical knowledge.

A last glimpse of Aldrovandi's remarkable book yielded interesting sections on grasshoppers (*Gryllo*), worms (*Vermibus* and *Vermibus plantarum*) and the humble earth worm (*Lumbricus terristibus*), with all

viridi ochroq; variãr. Aluus in aduncũ aculeũ orhrę colore desinit; capite Perlis similis est. Antẽnas habet mirę logitudinis, & tenuitatis, rubicũdas subrutilas. Nu. 2. Locusta capite & antennis Cochleã siue Domiportã ęmulatur. Capite, nisi oculi id proderẽt, carere videretur.

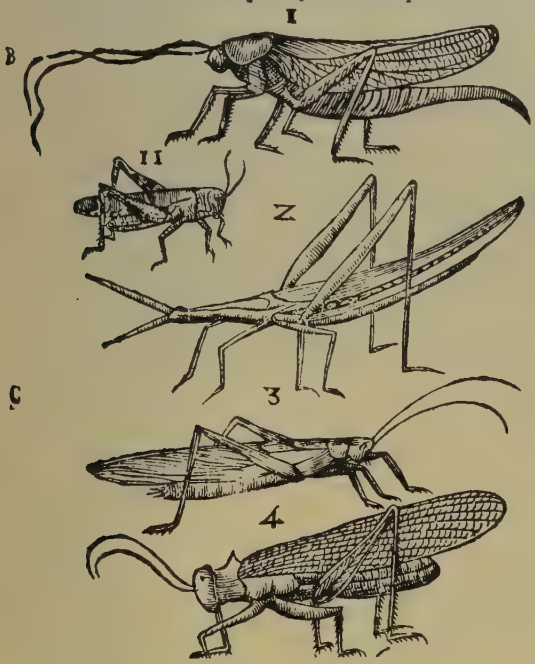


Fig. 1.

Antẽnę crassæ sunt, & crassa quòq; admodũ femora posteriorum pedum. Alas habet corpore protensiores. Vndiq; concolor sibi. Color est cinereo flauescẽs. Num. 3. Locusta est è genere vulgarium, vnicolor, viridis, prẽter antẽnas quæ lutescunt. Quarta tricolor Locusta vocari potest. Vulgo Frate hoc est monachus nominatur, nõ ob colorũ diuersitatẽ, sed quòd cucullata est. Caput collũ cucullatum, pectus, & femora posteriorum pedũ sunt viridia. Tibiæ verò corundẽ pedum sangui nei planè coloris: cætera omnia cinerea. Antennæ exiles, sursũ erectę. Quinta ex aculeatarũ siue caudatarũ genere, vbiq; vnicolor, viridis. Num. 6. exatro cinerea, vndiq; sibi concolor est. Septima ἀπτερος, Bruchus dici potest, fœtũ

Figs. 1, 2 and 3 comprise a series of three illustrations from Ulysses Aldrovandi's little known book on insects published in Bologna in 1602. The pictures are extremely well detailed and show acute and accurate powers of observation. The book was written in Latin. Engravings by And. Salmincius.

Fig. 2.

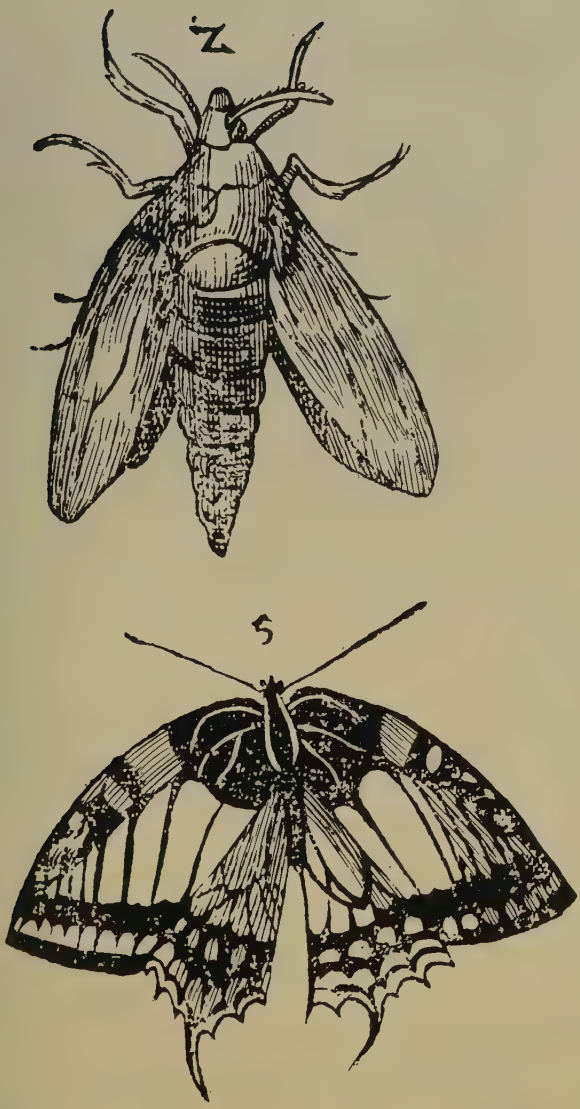


Fig. 3.

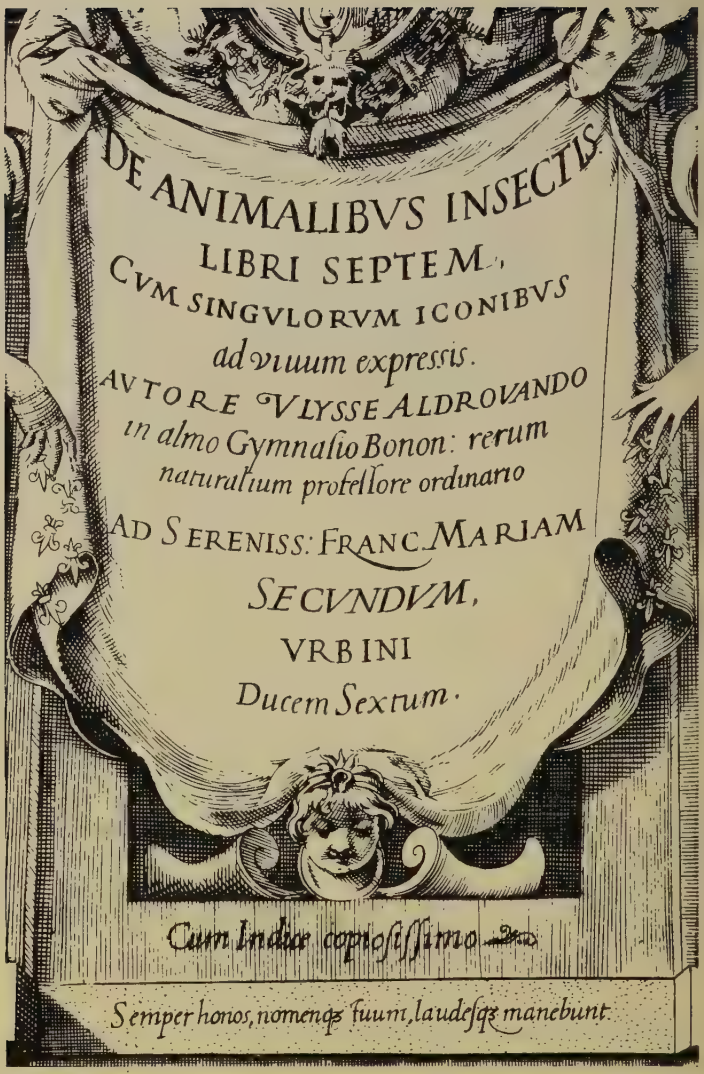


Fig. 4. Title Page

of which we are to-day familiar, and their value for aeration and other purposes appears to have been known and valued then as now.

Before finally closing the volume I turned to the title page (here reproduced) and to one bearing a drawing of the author, recalled again the oft quoted Virgilian Pastoral Poems and read with appreciation the inscription "Semper honos, nomenque tuum laudesque manebunt."

# SOME NOTES ON THE INSECT ECOLOGY OF CITRUS AND THE USE OF INSECTICIDES

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The past fifteen years have produced unprecedented advances in insecticides. The discovery of the insecticidal nature of DDT opened a new era in the control of pests which has continued at fever pitch for ten years. Enthusiasm has carried the discovery of new insecticides ahead of their exploitation, with the result that potentially dangerous chemicals are being widely used without detailed investigation of their effects. Many of the new insecticides are known to have disquieting results upon the complex of insect interrelationships. The almost complete eradication of many beneficial insects with modern insecticides has often been commented on, but few details have been thoroughly investigated. It seems to be time to take stock of our real progress.

There is probably no other crop with a more complicated interrelationship of insect fauna than that found on citrus. If a highly persistent insecticide were used on this complex then Volterra's law of "Disturbance of the Averages," which states that "if two species living together (one feeding on the other) are destroyed in proportion to their numbers, the average number of the prey increases and that of the predator diminishes," would apply with theoretical accuracy (MacLagan, 1951).

From Germany after the recent war, came the new organophosphorous insecticides. One of these, viz. parathion, is being developed, and there is every reason to believe that it will find its rightful place in the control of many citrus pests. In America more parathion is being used on citrus each year and it is rapidly gaining popularity in the South African citrus industry. Already it has been reported that soft scale, *Coccus hesperidum* Linn., has increased to damaging proportions after parathion treatment for the control of red scale and other pests. This is undoubtedly due to the elimination of the parasites which have always held soft scale in check. It can be expected that there will be further repercussions to the continued use of parathion.

Red scale, *Aonidiella aurantii* Mask., the most serious pest of citrus in many parts of the world, has around it a tangled mass of fauna

and facts. The biotic potential of this pest is enormous. A single adult female could in one year produce in the region of five million offspring if all factors of natural and artificial mortality were removed. Because of climatic, cultural, physiological and biological factors such a condition never arises.

In the Eastern Cape Province of South Africa, a few preliminary investigations have been made on the entomophagus associates of red scale. Although in this area the individuals of such a relationship may be very different from those in other parts of the world, the fundamental principles are the same.

## PARASITES OF RED SCALE

There are several small wasp parasites of red scale, the majority of which have originated in the East, the original home of both red scale and citrus. In South Africa the Aphenilid parasite, *Aphytis chrysomphali* (Mercet), is well established. This small, yellow, fast moving wasp is distributed throughout the citrus areas of South Africa and Rhodesia. There is no record of its importation, and it is presumed that the introduction was accidental. In Southern Rhodesia *A. chrysomphali* is found only during the summer months, and parasitises on an average of 1 to 2 per cent of red scale (Jack, 1916). In the Eastern Cape the degree of parasitism in chemically untreated orchards is from 10 to 17 per cent. In some areas the parasite has been observed throughout the year. In America, detailed studies of the life history and habits of *Aphytis* have been undertaken, but in South Africa such a study has been completely neglected. Some of the habits of this wasp are worth mentioning as they have a direct relationship with the chemical treatment of citrus.

The adult wasp flies quite strongly for its size, and with the aid of wind can quite easily migrate considerable distances. In the Sundays River Valley wind traps were placed between orchards, and, although the data thus obtained is fragmentary, it was established that *Aphytis* can migrate from one orchard to another. It was also noticed that *Aphytis* was present in orchards which had been fumigated with HCN four weeks previously. A similar observation has been made in a parathion treated orchard.

The adult *Aphytis* deposits its eggs next to the soft body of the scale insect by piercing a hole through the waxy scale covering. The young parasitic larva attaches itself to the scale insect by its mouthparts and thereby obtains its nutriment. Although *Aphytis* is in actual fact an ectoparasite, it is very well protected by the waxy covering of the scale. Reproducing and young stages of scale are not parasitised.

Apart from the scale mortality by direct parasitism, the adult wasps are also " host feeders," i.e. the adult mutilates and feeds on many scale insects, and it is reported that in this manner *Aphytis* probably accounts for more scale than it does by larval parasitism. The total control exerted by *Aphytis* is therefore much higher than the figures of parasitism shown.

It is obvious that *A. chrysomphali* is exceedingly beneficial in the control of red scale, and every effort to prevent its extermination by the indiscriminate use of insecticides should be encouraged.

*Aphytis chrysomphali* is not alone in parasitising red scale in South Africa. The indigenous Encytrid parasite, *Habrolepis rouxi* Comp., was first found parasitising citrus scale in the North Eastern Transvaal, and has more recently been collected in the Sundays River Valley. It is far less abundant than *Aphytis* and little is known of its habits. *H. rouxi* was introduced into America in 1936 and, although it did become established, nothing further has been reported. The fact that *H. rouxi* is indigenous to Africa whereas red scale is not, is encouraging. Further investigations on the parasites of red scale and their habits might be a worthwhile undertaking.

## PREDATORS

### Ladybirds

South African citrus groves are well endowed with predators of red scale. The beneficial effects of many ladybird beetles are well known to both entomologists and laymen. Unfortunately none of the *Coccinellidae* at present established in South Africa are specific predators of red scale. Many species live and reproduce satisfactorily on a diet of red scale, when circumstances are such that no other food is available. Their usefulness is however much reduced, as they tend to move to a more suitable host at a time when they are most required in the citrus orchard. The amount of control of red scale exerted by ladybirds and their larvae, although unmeasured, must be considerable.

In the Eastern Cape Province fourteen different species of *Coccinellidae* have been observed to feed on red scale both in the field and in the laboratory (Whitehead, 1948). Species such as *Pharoscymuns sexguttatus* Gyll. and *Lotis nigritula* Boh. are often very common in both fumigated and untreated orchards. Both adults and larvae of these species feed ravenously on the younger stages of red scale. Although such beetles and their larvae alone could never maintain an economic control of red scale, the part they play in biological control should not be overlooked. Adult scales are dealt with by the larger beetles. One of these, *Exochomus flavipes* (Thunb.), which is also a predator of the Cochineal insect introduced to control the prickly pear, is found in large numbers feeding on red scale at different times of the year. Another is the red spotted *Chilocorus solitus* Muls., a predator of the white aloe scale *Nelaspis humilis* (Br.). Although it is most commonly found associated with aloe scale, it also occurs on citrus, particularly where red scale populations are high.

### Lacewings, Moths, Bugs and Mites

Besides the fourteen coccinelid species already referred to, and there are probably many more, there are other predators which each contribute their part in this natural control complex. Among these are the larvae of lacewings, *Chrysopa vulgaris* Schon. being the most abundant in this area. The enshrouded larva of the moth *Eublemma*

Fig. 5.—A heavy infestation of soft scale, *Coccus hesperidum* Linn., on citrus. This pest can be controlled by parasites if the " balance of nature " is left undisturbed. In the photograph parasitised individuals are easily recognised by their dark colour, their convexity and shining surfaces. It has been found that soft scale builds up after treatment with parathion, presumably as a result of the elimination of parasites.

**Fig. 6.—A Grapefruit tree showing severe fruit drop and " die back," resulting from an unchecked infestation of red scale, *Aonidiella aurantii* Mask.**

**Fig. 7.—A Grapefruit tree on which a severe attack of red scale was checked by timely treatment with parathion.**

*costimacula* Saalm. although found only in small numbers, and only where the scale population is high, devours enormous quantities of red scale. Recently discovered in the Northern Transvaal are the predaceous Hemiptera, *Geocoris liolestes* Hesse, *Triphleps cocciphagus* Hesse and *Letaba bedfordi* Hesse (Hesse, 1945). The latter species has recently been found in the Eastern Cape preying on *Lepidosaphes beckii* (Newm.), locally known as citrus mussel scale, or the purple scale of America. Predatory mites are another link in the chain, but apart from a few recorded species little is known of their effect on the population of red scale.

## DISCUSSION

The above resumé of the predators and parasites of red scale in Southern Africa is not a complete picture, yet it is quite definite that the part they play in the biological control of red scale is considerable. Definite proof of this can be found in orchards where ants are abundant. It is often the case that trees with a large population of ants are heavily infested with red scale, whereas neighbouring trees with a low ant population have a correspondingly low proportion of scale. Ecological counts of the red scale predators in some orchards in the Sundays River Valley show a decline in numbers of predators with a rise in numbers of ants.

With the insecticidal treatment of citrus there is grave danger of upsetting the " balance of nature," as is done by ants. For the past fifty years red scale has been controlled by fumigation with HCN. Repercussions to such treatment have not been disastrous, for which there are probably many reasons. HCN fumigation is usually carried out at night, and is a slow and laborious process. Each tree is covered with a canvas tent, during which process many parasites and predators have time to escape to surrounding trees. Although HCN is lethal to the majority of insects, it has no residual effect, and thus only kills those insects present at the time of fumigation.

It is expected that treatment with parathion would be entirely different. With modern machinery, large areas of citrus can be treated in a very short period leaving no time for beneficial insects to migrate. Furthermore, parathion has a residual effect of at least three days. Any insects which perchance evade a lethal spraying, and any that might migrate from surrounding areas would be completely exterminated over that period, either by contact or poisoned by the parathion in their dead or moribund hosts.

The indiscriminate use of parathion may not show any adverse effect initially, but it may be noticed in later years. The effect of parathion on beneficial insects should be as carefully investigated as its effect on the pest for which it is applied. Parathion is seldom completely effective against red scale, for a percentage of live scale is usually found on parathion-treated trees. The control of these survivors before they have had time to re-establish themselves would greatly increase the effectiveness of treatment. It is possible that parasites

and predators might be effectively employed for this purpose. Ways and means should be sought to use parathion complementary to, and not at the expense of, biological control.

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Jack, R. W.—1916. Rhodesian Citrus Pests. Rhodesian Agric. Jour. XIII (2): 33—215.

MacLagan, D. S.—1951. Modern Insecticides and the Balance of Nature. Nature. 168 (4270): 360—362.

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# THE CONTROL OF MEALYBUGS ON VINES WITH CHEMICALS

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THE damage caused by mealybugs on vines is widely known and recognised. At times the insects become pests of considerable economic importance, and active control measures have to be taken. In this article we will discuss the mealybug problem in the Western Cape Province, particularly the Hex River Valley, one of the most important table grape producing areas of South Africa. Something old and something new will be mentioned about control measures, for HCN once played an important part in the fight against mealybugs, and parathion now offers new approaches.

## MEALYBUGS

Two species of mealybug are found in the Hex River Valley; the grape mealybug (*Pseudococcus maritimus* Ehr.) and the citrus mealybug (*P. citri* Risso.) The latter is sometimes called the " wet mealybug " because of the large amount of honeydew which it secretes.

The life histories of the insects are briefly as follows. Overwintering stages, including eggs, larvae and adults, shelter under the bark on the trunks of vines. When the vines are well covered with new shoots and leaves in November and December, the mealybugs crawl upwards and settle down on the new growth, in leaf axils and at the bases of shoots and stems. Later in the season they may be found on the underside of leaves and inside bunches of fruit. Eggs are laid in cottony ovisacs. There may be several generations in a season.

Mealybugs suck the sap from leaves and stems by means of their long probosces. This causes wilting and weakening of the vines in a serious infestation. Most damage however, is caused by honeydew, which is secreted by every individual insect. Honeydew attracts ants and, in the Hex River Valley, it is the Argentine ant (*Iridomyrmex humilis* Mayr.), which tends the mealybugs and protects them from parasites and predators. Eventually the honeydew becomes covered with sooty mould, and the grapes are unsaleable.

Mealybugs usually infest a patch of vines among a vineyard, rather than a whole area. Sometimes they keep more to one particular variety, and sometimes they seem to keep to individual vines. Thus one vine may have a big mealybug population, while the adjacent one may have practically none at all. Every farmer has to be on the watch for the pest, and a periodical check round the vineyard is a very wise precaution, particularly during November and December, when the mealybugs are on the move.

Insects with soft bodies, like mealybugs, offer easy prey to parasites and predators. On citrus trees mealybugs have been controlled in a classic manner by biological means. The ladybird beetle (*Cryptolaemus montrouzieri* Muls.) has played the most prominent part in such campaigns. The secret of success rests with the ants and, if they are kept away from the mealybugs, parasites and predators are given a fair chance to do their good work. Ant control is thus an important part in the biological control of mealybugs. This aspect of the problem falls outside the scope of the present paper.

## FUMIGATION

In " Plant Protection Overseas Review ", Vol. 2, No. 2, April 1951, Whitnall pointed out how Liquid HCN had first been used in South Africa for plant fumigation. The plants treated were grape vines and that work of Mally's in 1914 was destined to have far reaching effects on fumigation procedure.

Vines were never fumigated for mealybug control as extensively as citrus trees were for control of scale insects but, where severe infestations of mealybugs occurred on vines, fumigation with Liquid HCN proved a most successful method of fighting the pest. In 1938 about 300 miles of low trellis vines were fumigated, and in 1939 something like 700 miles were successfully treated in the Hex River Valley.

Fumigation of the deciduous vine was a fairly simple process compared to treatment of evergreen citrus. Vine fumigation was carried out during daylight in the winter months, June, July and August, when the vines were dormant and could withstand a concentration of gas which was fatal to the mealybugs. Work had to be completed before the buds swelled in the spring. When treated in winter there was little danger of injury to the vines.

While porous canvas covers were used for fumigating evergreen citrus trees at night time during summer, covers treated with gas proofing material were necessary for fumigating dormant vines during the day time in winter. For trellised vines, a long tent, 100-ft. x 12-ft., was fitted over the trellis like an inverted V and the ends clamped so as to be quite gas tight. Soil was placed on the cover where it touched the ground. Dosage was determined by calculating the volume of the space enclosed, and the gas was applied by the Hydro-cy pump at two or three places along the tent. One 18 cc. unit of liquid HCN was given per 100 cu. ft. Tents were left in position for 45 minutes or longer. When dosed on this basis, the

**Fig.8.—MEALYBUGS**

**Top row. Adult females of the grape mealybug, *Pseudococcus maritimus* Ehr. Bottom row. Adult females of the citrus mealybug, *P. citri* Risso. Both species are found in vines in the Hex River Valley. The citrus mealybug is sometimes called the "wet mealybug" because of the large amount of honeydew which it secretes.**

**Fig. 9.—Mealybugs on the leaf of a vine.**

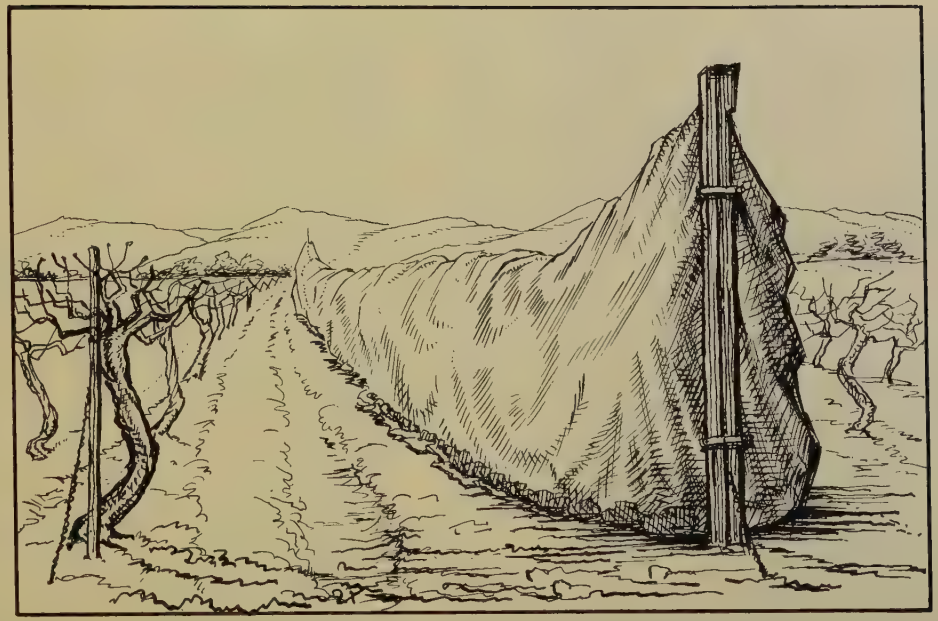

Fig. 10. — A 100 ft. gas tight tent in position over low trellis vines. Hundreds of miles of vines in the Hex River Valley were fumigated with HCN in 1938 and subsequent years.

initial concentration of gas under a vine fumigation tent was about the same as that given to a citrus tree on dosage chart standards. In citrus fumigation the gas leaked rapidly through the porous tents, and little remained after 30 minutes. In vine fumigation the leakage was slow and after 45 minutes the concentration of gas had not even fallen by half. High gas concentrations maintained over long periods could be tolerated by dormant vines. These conditions made it possible to obtain excellent control of all stages of mealybugs on vines with HCN. Similar methods could never be employed to control mealybugs on citrus.

Fumigation had certain other advantages in addition to the control of mealybugs. One of these was the control of erinose. The mite causing this leaf disease is *Phyllocoptes vitis*, and it hibernates on the vine, being ready to attack the leaves as soon as they appear. Fumigation with HCN killed the overwintering mites, and the vines commenced the growing season free from this pest.

Another striking effect which HCN had on vines was a stimulation of dormant buds. Fumigation caused the vines to sprout earlier and to make stronger and more even growth.

## PARATHION

Fumigation gave excellent control of mealybugs and had other advantages as well, so that any improved method of control had to stand severe tests. Parathion dusts and sprays stood these tests and have now taken over the work of HCN fumigation as regards the mealybug problem on vines and, in many citrus areas, the scale insect problem as well. Parathion, like HCN, is a potent insecticide. Both suffer from the disadvantage of being poisonous to man. Parathion is, however, more convenient to handle and is thus perhaps safer to use.

Experiments have shown that of several of the new organic phosphate insecticides tested as sprays and dusts, the quickest and most complete kill of mealybug is obtained by using parathion. In one experiment where a 15% wettable powder was used at the rate of 2 lb. per 100 gals. water, the spray killed well over half the mealybug population in the first week, while the remainder was dead by the thirteenth day after treatment. Only one small colony was found alive at the end of a fortnight on the treated vines, while on the unsprayed controls the mealybug population had increased.

## TIMING APPLICATION

The time of application of parathion during the summer is very important. If applied too early the control may be poor as some mealybugs may be still hibernating under the bark and so escape treatment. Too late an application may mean that residues are left on the fruit at picking time. Sprays made from wettable powders have longer lasting residues than those made from dispersible liquids. The latter are thus popular with table grape producers as any blemish on the fruit is a serious disadvantage. Dusts, especially those com-

pounded with sulphur, also have their use. If treatment is within three weeks of picking time, there may also be the danger of parathion itself being on the fruit. Careful timing is thus essential. In general, the right time to apply parathion is after the berries have set and are swelling, but before the mealybugs can be found inside the bunches. Once the mealybugs have moved from the main stem along the branches and honeydew has spoilt the appearance of the grapes, and white ovisacs have been deposited in the bunches, there is little that can be done to improve the fruit.

## PRESENT PRACTICE

The present recommendations for the control of mealybugs on vines includes a winter spray of lime sulphur. (10 gals. 32% L.S./90 gals. water). This is a good " cure-all " for vines. Besides killing some hibernating mealybugs it helps to control anthracnose, erinose and oidium. This treatment is followed by either dusting or spraying with parathion during early summer. In the Western Cape Province this would mean that during December, depending on the area and how far the season had advanced, those vines which were known to be infested at the previous harvest would receive a thorough dusting with 2% parathion-in-sulphur, or else a cover spray containing about 0.03% parathion. A second treatment may be necessary later after an interval of about ten days. This is best determined by the farmer, who should keep a careful watch on mealybug movements.

The sulphur in the parathion dust is a recognised fungicide for use during spring and summer against anthracnose and oidium. Sulphur is also recommended as a control measure for the erinose mite, *Phyllocoptes*.

It is unwise to apply parathion to vines if the infestation of mealybugs is slight. If all mealybugs are killed by chemicals then the numerous parasites and predators will be killed too, by both the chemical poison and the absence of food. It is better to keep some parasites and predators present in the vineyard to assist with any big mealybug outbreak that may occur. That is why only the vines that were known to be infested during the previous season are treated with parathion.

Yesterday entomologists thought that HCN fumigation was the best method to control mealybugs on vines and scale insects on citrus trees. Today they think that parathion offers better prospects. Who knows what tomorrow will bring ?

# TECHNICAL BREVITIES

*This section includes information on plant protection problems in their widest sense, which has been obtained from published literature. We give references to the publications concerned.*

## INSECTICIDES

### MOSQUITO BLIGHT OF TEA CONTROL

DUSTING with 4% DDT has been so successful against mosquito blight, *Helopeltis theivora*, that it has become routine practice on estates in Central and South Travancore, South India. A crop increase of 100 lb. per acre resulted in Central Travancore. The pest population has been so reduced in many areas that the original schedules have been cut. Build-up of red spider, *Tetranychus bioculatus*, is now a problem.

*Rau, S.A., Rep. Un. Plant Assoc. S. India, Sci. Dep.*, 1950-1, 1951: 11-12.

### BHC SYSTEMIC ACTION: PERSISTENCY AND TRANSLOCATION IN PLANTS

When BHC is applied to plant surfaces, its toxicity may be reduced by heavy rains within the first 24 hr., but not by subsequent rains, and its persistency is not affected by temperature. Toxicity of lower concentrations of BHC is less persistent than that of higher ones, and a persistency of 16 days can be expected only from preparations containing at least 5% gamma isomer. When first applied to foliage, BHC has a contact and a fumigant action, but these disappear within a few days owing to penetration of the BHC into the plant. After this, BHC acts as a stomach poison and insects are harmed only if they eat plant tissues. There is a definite translocation of BHC from treated to untreated parts of the plant. Thus, when the lower leaves of young potato plants were brushed with a BHC paste, the new leaves become toxic to 1st stage larvae of the Colorado beetle, these dying in a few days. Potato tubers dusted with BHC or dipped in BHC emulsion, and untreated tubers planted in soil on which a BHC emulsion was subsequently poured, all gave rise to plants the foliage of which was toxic to larvae of the Colorado beetle—and remained toxic up to flowering time.

*Thiem, E., NachBl. dtsch. PflSchDienst, Berlin*, 1951, 5 (2): 24-30.

## ARMY WORM CONTROL

In cage tests on maize in Ohio against the army worm, *Cirphis unipunctata*, using sprays of parathion and gamma-BHC at 0.5 lb. per 100 gal. and other insecticides at 1 lb. per 100 gal., kill of larvae after 72 hr. ranged from 96.4% for parathion to only 5.1% for gamma-BHC, with toxaphene, chlordane and DDT between these extremes.

*Hibbs, E. T. and Weaver, C. R., J. econ. Ent.*, 1951, 44 (1) : 122.

## ARMY WORM CONTROL

Extremely effective control of the army worm, *Sideridis* (*Persectania*) *ewingi*, which causes much damage to cereal grain and grass seed in the field in Tasmania, is given by dusting with 2% DDT at 28 lb. per acre six weeks before harvesting. This dosage could probably be decreased.

*Miller, L. W. et al, Tasm. J. Agric.*, 1951, 22 (3) : 251-257.

## COTTON INSECT CONTROL : S. AFRICAN RECOMMENDATIONS, 1951-2.

Official recommendations against cotton pests in South Africa for the 1951-2 season are detailed. For red bollworm (*Diparopsis*) and spiny bollworm (*Earias*) the best treatment is thought to be dusting with 1% parathion + 7½% DDT at 10 to 15 lb. per acre, but this is reluctantly recommended owing to its hazard to man. Alternatives include dusting with 10% DDT or 20% toxaphene or spraying emulsions supplying 1 to 1½ lb. per acre actual DDT or 2 to 3 lb. per acre actual toxaphene or with wettable powders supplying 1 to 1½ lb. per acre DDT or 0.3 lb. per acre gamma BHC. Two applications 3 to 4 days apart should be made when the bollworms appear, with repetitions when necessary. For heavy cotton aphid attack use may be made of BHC 3% gamma isomer or 1% parathion, each at 10 to 15 lb. per acre. The 1% parathion dust is recommended against red spider. Young cotton stainers (*Dysdercus*) are controlled by 10% DDT or 20% toxaphene dusts, but for older stainers 1% gamma-BHC or 1% parathion dusts are advocated.

*Fmg. S. Afr.*, 1951, 26 (305) : 278-281.

## RICE MIDGE CONTROL

Rice in S.E. France is subject to damage by the minute, transparent larvae of a midge, *Cricototus trifasciafus*. The critical period is at the very start of germination when the developing embryo is attacked and may be destroyed. Successful results are being obtained by applying a commercial product composed of DDT, gamma BHC and Octochlor (? chlordane) as a liquid at 1 p.p.m. in the water entering the rice field. This rapidly kills larvae. Biological observations show that application should be made as soon as the water contacts grain just starting to germinate.

*Risbec, J.*, C. R. *Acad. Agric. Fr.*, 1951, 37 (12) : 461-463.

## RHINOCEROS BEETLE CONTROL

Spraying 0.01% BHC on manure heaps, vegetable refuse, and other breeding sites of the rhinoceros beetle, *Oryctes rhinoceros*, which is a pest of coconuts, is an effective means of destroying the grubs. BHC at this rate gave complete kill of grubs and continued to do so for at least six months, though adults were not prevented from ovipositing on the treated material. Toxaphene was less effective. Arsenicals were effective at over 0.05% but too hazardous to be recommended. DDD was poor.

*Nirula, K.K. et al, Indian Coconut J.*, 1951, 4 (2) : 49-56.

## SEED-CORN MAGGOT CONTROL : SEED TREATMENT

Adequate protection of lima beans against seed-corn maggot, *Hylemya* (*Delia*) *cilicrura*, and wireworms is obtained in North Carolina without adverse effects by seed treatment with gamma-BHC (75% lindane at 0.33 oz. per bu. or of 25% lindane at 1 oz. per bu.) combined with tetrachloro-p-benzoquinone or thiram as a fungicide. Widespread use has been made of the treatment as dusts or slurries.

*Lange*, W. H. *et al.*, *J. econ. Ent.*, 1951, 44 (2) : 202-208.

## TERMITE CONTROL BY BHC

In Tanganyika BHC placed near groundnut seed at sowing time at the rate of 4 oz. gamma isomer per acre can control attack of termites on the maturing crop.

*Bunting, A. H., Nature, Lond.*, 1951, 168 (4280) : 806.

## RED SPIDER CONTROL IN ORCHARDS

In Switzerland orchard spraying against fruit tree red spider, *Paratetranychus pilosus*, has been found to be inadequate if greenhouse red spider, *Tetranychus telarius*, and *Bryobia praetiosa* are also present. Differences in the biology of the three pests must then be taken into account. With *P. pilosus*, spraying should be done after flowering, when the active stages first appear, but before egg laying starts three weeks later. With *B. praetiosa*, treatment should be given before flowering as the active stages appear then. With *T. telarius*, the active stages appear before flowering but immediately migrate to undergrowth and do not occur on the trees until mid-summer, so that sprays should then be applied.

*Grob*, H., *Mitt. schweiz. ent. Ges.*, 1951, 24 (3) : 263-77.

## ORIENTAL FRUIT MOTH CONTROL

Oriental fruit moth (*Laspeyresia* (*Ernarmonia*) *molesta*) attacking late varieties of peach in France can be controlled by three applications (46, 34, and 24 days before harvesting) of a mixture of 400 g. of 50% DDT wettable powder + ½% summer white oil.

*Besson, J. and Joly, E., C.R. Acad. Agric. Fr.*, 1951, 37 (12) : 439-441.

## FRUIT TREE RED SPIDER CONTROL

In trials in New York against fruit tree red spider (*Paratetranychus pilosus*) TM-289 (21.5% dinitro-sec-butyl-phenol) at 0.75% was inferior to 2% petroleum oil in killing winter eggs. Applied to apple trees prior to bloom, 1% petroleum oil and (I) p-chlorophenyl-p-chlorlbenzene-sulphonate gave excellent early season control and was superior to any other winter ovicide spray tested. Against summer infestations, 8 organic phosphorous compounds were highly effective and a single application of I persisted for a month. Spraying the ground cover with two systemic insecticides, schradan and trialkyl-thiophosphate (Systox) gave promising results.

*Lienk, S. E. and Chapman, P. J., J. econ. Ent.*, 1951, 44 (3) : 301-306.

## CITRUS PEST INCIDENCE : ROLE OF ANTS

Ant infestation in citrus groves may cause serious increases in the populations of California red scale, citrus red mite, citrus aphids, citrus mealy bug, soft-brown scale, black scale, and yellow scale. Ants show no special interest in red scale and red mite, which do not secrete honeydew, but they attack and kill most natural enemies of citrus pests. Satisfactory biological control cannot be attained where ants are abundant. The Argentine ant is the worst offender. Ant control is therefore important.

*De Bach*, P., *et al*, *Calif. Citrogr.*, 1951, 36 (8) : 312-313, 347-348.

## APPLE THRIPS CONTROL

In years favourable to the apple thrips, *Thrips imaginis*, in South Australia, the apple crop may fail owing to destruction of pollen by this pest. The best control measure is spraying with 0.1% DDT at the early pink bud stage and again when 50 to 75% of the flowers have opened. No bee poisoning was observed after treatment.

*Andrewartha, H. G. and Kilpatrick, D. T., J. Dep. Agric. S. Aust.*, 1951, 54 (12) : 586-592, 595.

## RESISTANCE OF POLLEN BEETLES TO INSECTICIDES : effect of age and fatty bodies

Young pollen beetles (*Meligethes aeneus*) are more resistant to insecticides such as derris and DDT dusts than more mature forms. Resistance is correlated with the very much greater development of fatty bodies in the young beetles. In spring, when only old beetles having very little fat are present in the crops, a normal dusting of DDT gives satisfactory kills : but a sharp change occurs towards the end of June as the young beetles begin to appear and resistance increases, so that the double and treble doses are needed for control. The findings are also important in the laboratory evaluation of insecticides.

*Frey, W., Z. angew. Ent.*, 1950, 31 (4) : 609-16.

## WIREWORM CONTROL BY PARATHION

In the U.K. a heavy wireworm attack on a newly planted sprout crop was controlled by watering 0.1% parathion around the plants.

*Grower*, 1951, 36 (1) : 18.

## SQUASH BUG CONTROL BY SCHRADAN

In cage tests in Kentucky, schradan applied to squash plants 6 to 8 in. high against the squash bug, *Anasa tristis*, gave 58% kill in 7 days at 1 lb. per 100 gal. and 100% kill in 7 days at 2 lb. per 100 gal. Complete kills were given in 1 day by a 1.5% lindane dust, and in two days by 0.5% parathion and by 1% dieldrin dusts. Aldrin, methoxychlor, and DDT were slower acting. Sabadilla and CPR gave poor kills.

*Rep. Ky. Agric. Exp. Sta.*, 1950, 1951 : 30.

## STRAWBERRY LEAF ROLLER CONTROL

In Wisconsin out of 9 insecticides only parathion gave effective control of the strawberry leaf roller, *Ancylis comptana fragariae*, when the larvae were enclosed in the leaves. It was also good either as a 2% dust at 35 lb. per acre or as a spray at 1 lb. of 25% wettable powder per 100 gal.

*Chapman, R. K. and Whipp, A. A., J. econ. Ent.*, 1951, 44 (3) : 424-425.

## POLLEN BEETLE CONTROL

Field experience in France has shown that as little as 0.96 kg. technical BHC per ha. (about 0.13 kg. gamma isomer) or 0.36 kg. parathion give almost complete destruction of pollen beetles (*Meligethes* spp.) attacking brassicas.

*Bonnemaison, L., C. R. Acad. Agric. Fr.*, 1951, 37 (12) : 441-444.

## MEXICAN BEAN BEETLE CONTROL

Complete control of larvae of the Mexican bean beetle, *Epilachna varivestris*, in Kentucky was given by 15% parathion at 1 lb. per 100 gal. and by 25% Dilan at 1 pt. per 100 gal. EPN 300 at $\frac{3}{4}$ lb. per 100 gal. gave 67% control and schradan at 2 lb. per 100 gal. only 57%. Two applications were made to snap beans using 64 gal. per acre when the plants were 4 to 5 in. high and spraying 10 days later using 128 gal. per acre.

*Rep. Ky. Agric. Exp. Sta.*, 1950, 1951 : 29.

## MILLIPEDE CONTROL ON STRAWBERRIES

In Kentucky satisfactory control of millipedes on strawberries without causing taint was given by spraying lindane as a 20% emulsion at 1 qt. per 100 gal. when the foliage was thoroughly wet, and by dusting at 40 lb. per acre with 20% toxaphene, 2% parathion, 5% chlordane or 2.5% aldrin.

*Rep. Ky. Agric. Exp. Sta.*, 1950, 1951 : 28.

## TURNIP APHID CONTROL

Applied to kale and turnip against the turnip aphid, *Rhopalosiphum pseudobrassicae*, in Kentucky, schradan at 2 lb. per 100 gal. and 75 gal. per acre gave 95% control four days after treatment and remained effective for two weeks.

*Rep. Ky. Agric. Exp. Sta.*, 1950, 1951 : 29-30.

## WHITE GRUB CONTROL

In Porto Rico commercial control of white grub, *Phyllophaga portoricensis* and *P. vandinei*, is given by 2 lb. per acre of gamma-BHC or aldrin. But in laboratory tests gamma-BHC at 10 lb. per acre did not kill grubs of the West Indian weevil root-borer, *Diaprepes abbreviatus*, whereas aldrin at 0.5 lb. per acre killed them all.

*Wolcott, G. N., J. Econ. Ent.*, 1951, 44 (1) : 58-60.

## SANDHILL CUTWORM CONTROL

Excellent control of the sandhill cutworm, *Euxoa detersa*, was given by DDT at 1 lb. per acre as a spray in Nebraska. BHC at 1 lb gamma-isomer per acre was inferior, as were chlordane and toxaphene.

*Hill, R. E. and Martin, H. M., J. Econ. Ent.*, 1951, 44 (1) : 90-92.

## LEATHERJACKET CONTROL

In the U.K. a dressing per acre of 1 lb. 50% wettable BHC mixed with 25 lb. bran is a cheap and satisfactory substitute for Paris Green for control of leatherjackets (*Tipula* spp.). If there is a risk of crop tainting, use may be made of 1 lb. 20% wettable DDT mixed with 28 lb. bran, but under wet conditions DDT is very slow acting and BHC is far better.

*Notes and News* (*Berks A.E.C.*) *No.* 115, 1952, (*Feb.*) : 2-3.

## WHITE GRUB CONTROL

Larvae of the green June beetle, *Cotinis nitida*, in sod in Kentucky were well controlled for 4 years by lead arsenate top dressed at 1 or 2 lb. per 100 sq. ft. When raked into the top 2 in. of garden soil, BHC at 2 or 3 lb. gamma isomer per acre and parathion at 3 or 4 lb. per acre were effective, and lindane at 2 lb. per acre gave fair control ; but DDT at 60 lb. per acre, chlordane at 10 lb. per acre and aldrin at 5 lb. per acre were not effective. A 1% parathion dust on plant beds at 2 lb. per 1,000 sq. ft. was satisfactory.

*Jewett, H. H., Bull. Ky. Agric. Exp. Sta., No.* 559.

*Via Agric. Chemicals*, **6** (7) : 77.

## BENEFITS FROM INSECTICIDES IN U.S.A.

Numerous examples are given of outstanding benefits to agriculture and forestry derived in recent years in the U.S.A. from the use of insecticides. The total gains have a value several times greater than the expenditure for insecticides of $60 million in 1948. Instances of

national benefits are : use of DDT has reduced annual apple losses caused by codling moth from 15% of the crop value to 3 to 5% ; control of potato pests has increased average yields of potatoes from 155 bu. per acre in 1945 to 211 bu. per acre in 1949 ; every $1 spent on grasshopper control in 1949 saved crops valued at $55.

*Bishopp, F. C., Agric. Chemicals*, 1951, 6 (7) : 46-48, 105-7.

### WHITE-FRINGED BEETLE CONTROL

In South Africa biology of the white-fringed beetle, *Graphognathus* (*Pantomorus*) *leucoloma* is described. This pest has a wide host range and damages various crops in the union. Repeated spraying or dusting the foliage of shrubs and ornamentals (but not food crops) with DDT or cryolite is recommended. Excellent results have also been obtained by soil treatment against larvae using DDT at a dosage equivalent to 10 lb. per acre of technical material ; the land should first be ploughed, and the DDT then broadcast and harrowed into the top 3 to 4 in. Soil treatment gives control for several years.

*Joubert, C. J., Fmg. S. Afr.*, 1951, 26 (303) : 195-197.

## FUNGICIDES

### SEEDLING DISEASE OF SUGAR BEET CONTROL

In Ohio the most effective treatment against seedling diseases of sugar beet, chiefly black root disease caused by the water mould, *Aphanomyces cochlioides*, was seed treatment with thiram as a dust or slurry in addition to thiram at 3 to 6 lb. per acre mixed with fertilizer and drilled with the seed. It seemed possible that enough thiram could be applied to the seed to give adequate control without applying any in the fertilizer. Preliminary trials indicate that the fertilizer-thiram combination may be more effective in the top soil than when placed with the seed. Seed was not injured by heavy dosage of thiram.

*Kazmaier*, H. E. *and Young, H. C., Rep. Ohio Agric. Exp. Sta.*, 1949-50, 1951 : 35.

### LEAF SPOT OF BEET CONTROL

Seed dressing of beet with an organic mercurial or a copper oxychloride dust is recommended in New South Wales against leaf spot of silver beet and beetroot caused by *Cercospora beticola*. Spraying is not usually worthwhile but, if the disease appears early, Bordeaux 1-1-10 may be applied after removing infected leaves, giving a second spray 7 to 10 days later.

*Agric. Gaz. N.S.W.*, 1951, 62 (7) : 373-374.

### DOWNY MILDEW OF HOP CONTROL

Four years' trials in Ontario have demonstrated the superiority of spraying over dusting against downy mildew of hops, caused by *Pseudoperonospora humuli*. Recommendations are to spray at intervals

of 10 days in wet weather or 14 days in dry, from the time the vines are 6 to 8 ft. high till the cones begin to form, using Bordeaux mixture 10-10-100 or 10-5-100 or a fixed copper with a spreader-sticker. If powdery mildew appears thereafter, the hops should be dusted with sulphur. Good cultural practices are important.

*Richardson, L. T. and MacLachlan, D. S., Sci. Agric.*, 1951, 31 (8) : 345-348.

## LEGUME SEED DRESSING : TOXICITY TO RHIZOBIA

Although seed protectants containing mercury, copper or zinc are extremely toxic to rhizobia used for inoculating leguminous seed, culture tests show that Spergon (tetrachloro-benzoquinone), Phygon (dichlornaphthoquinone) and Arasan (thiram) were less toxic to 7 species of rhizobia. Arasan was toxic to all species but did not affect them equally. Phygon was moderately inhibitory to all except the bean organism, which it did not harm. Spergon inhibited the clover and cowpea rhizobia, but had little or no effect on lucerne, pea or bean organisms. More organisms survived exposure to these chemicals in moist than in dry soil, indicating that when chemical coated seed is inoculated and sown in moist soil enough rhizobia may survive to be effective. Other workers have shown rhizobia can migrate in moist soil at the rate of 25 mm. in 24 hours, so that the organisms could probably escape from the toxic area.

*Rhuloff, M. and Barton, J. C., Soil Sci.*, 1951, 72 (4) : 283-290.

## VIRUS INHIBITION BY GROWTH REGULATORS

Indolebutyric acid at 10 mg. per 1., like napthaleneacetic acid at 1.0 mg./1., is effective in reducing the concentration of tobacco mosaic virus in tobacco stem tissue cultures. 19 other substances were ineffective, including phenylacetic acid at 10 mg./1.

*Kutsky, R., Science*, 1952, 115 (2975) : 19-20.

## BLACKARM OF COTTON CONTROL : SEED TREATMENT

Seed treatment of cotton in Madras with formalin, formalin-charcoal dust, ' Ceresan ' or ' Agrosan ' G protected seedlings from primary infection by the blackarm organism, *Xanthomonas malvacearum*, but secondary infection from neighbouring crops nullified the benefit. To be of appreciable value seed treatment must be carried out over the whole area, and sources of secondary infection, such as plant debris, must be absent.

*Ramakrishnan*, T. S., *and Ramakrishnan*, K., *Indian Phytopathology*, 1950, 3 (1) : 64-74.

## BROWN ROT OF APRICOT CONTROL

Brown rot of apricot caused by *Sclerotinia fructicola* is responsible for loss of half the crop in Tasmania in seasons favouring the disease : the blossoms wilt and die, twigs are blighted, and the ripening fruits become infected by air-borne spores and mummify. Good control

is given by a thiram product ( ' Thiotox ' ) at 1½ lb. per 100 gal. as cover sprays applied no later than three weeks before picking, and an additional pre-pick spray reduces brown rot in storage. ' Shirlan ' AG at 1 lb. per 100 gal. is also effective, but doubt has been expressed as to toxicity of the residue. Neither fungicide injured the trees nor adversely affected the canned fruit. All other fungicides tested as cover sprays, including nabam, ferbam, ziram and lauryl isoquinolinum bromide, caused tree injury or left objectionable residues. Orchard sanitation is important.

*Wade, G. C., Tasm. J. Agric.*, 1951, 22 (3) : 258-266.

## BLACK ROT AND BLACK LEG OF CABBAGE CONTROL

Chemical measures recommended in South Africa for control of the brassica diseases, black rot caused by *Bacterium campestre* (*Xanthomonas campestris*) and black leg caused by *Phoma lingham* are :— weekly spraying of seedlings with Bordeaux or dusting with copper-lime ; seedbed sterilizing with mercuric chloride at 1 : 1000 ; and seed treatment either using mercuric chloride at 1 : 1000 followed by rinsing in clean water or steeping for 25 minutes in water at 122 F.

*Wagner, V. A., Fmg. S. Afr.*, 1951, 26 (305) : 258-260.

## RED STELE OF STRAWBERRY CONTROL : NABAM AS SYSTEMIC FUNGICIDE

Red stele disease of strawberry, caused by *Phytophthora fragariae*, is controlled by soil applications of Dithane D 14 (nabam). There was evidence in pot experiments that the material acted systemically and not as a soil sterilant, but in field trials with Dithane D 14 at 1.5 parts to 100 parts water, injected under pressure into infected soil at 2,000 gal. per acre, it seemed probable that the chemical acted both ways.

*Stoddard, E. M., Phytopathology*, 1951, 41 (9) : 858.

## ROOT ROT CONTROL : SOIL FUMIGANT PLACEMENT BELOW SEED

For controlling root rot of peas and beans, R. D. Watson of Idaho Agricultural Experimental Station has used a drip process based on the new onion smut control method to place soil fungicides at sowing time below the seed so that they will be dissipated before causing injury. Formaldehyde was phytotoxic at 4.7 gal. per acre but gave control of foot rot and increased yields at 1.5 gal. per acre. Technical chlorobromopropene, formerly coded O.S. 840, gave increasing control when tested at up to 2 gal. per acre without causing any injury.

*Agric. Chemicals*, 1951, 6 (9) : 59, 104.

## DUTCH ELM DISEASE CONTROL : NEW SYSTEMIC FUNGICIDES

Connecticut Agricultural Experimental Station has reported that Dutch elm disease (*Ceratostomella ulmi*) was held in check in 1951 by

systemic fungicides such as oxyquinoline benzoate. A new agent, 2-methylcarboxymercapto-benzo-thiazole, cured all but 5% of infected trees in an experimental plot. It will be tried out in practice in 1952. Instead of being applied to the soil, it is sprayed on the leaves.

*Chem. Engng. News.*, 1951, 29 (52) : 5245.

## EELWORM CONTROL BY ETHYLENE DIBROMIDE

A resumé of progress reports on soil fumigation with ethylene dibromide in the U.S.A. shows that applications of 10 to 12½ gal. per acre of 40% material and 4½ to 6½ gal. per acre of 85% material on eelworm infested soils have given good results on tobacco, carrot, celery, cotton, lima bean, sweet potato, sugar beet, groundnut, tomato, pine seedlings and melons. Good soil preparation is necessary and the soil moisture content must be high at the time of application—fumigation of dry soil fails. Good sealing is required. Fumigated soil should not be disturbed for 7 to 8 days. Planting can be done after 14 days.

*Biron, R. A., Down to Earth*, 1951, 7 (2) : 6-9.

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